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THE GEOLOGICAL HISTORY OF SEA-LEVEL.

The Face of the Earth (*Das Antlitz der Erde*). By Prof. Eduard Suess. Translated by Dr. Hertha B. C. Sollas, under the direction of Prof. W. J. Sollas. Vol. ii. Pp. vi+556; illustrated. (Oxford: Clarendon Press, 1906.) Price 25*s.* net.

THE first volume of this translation has been previously reviewed in NATURE, and we can renew our congratulations to the translator on her admirable rendering of this great work. Prof. Suess's eloquence depends on his ideas and his poetical imagery, and thus his writings suffer less by translation than those of most men. Doubt may be felt whether some of the proposed equivalents of technical terms, and such words as quer-Andian, will be generally adopted in English. In reading the volume it is necessary to remember that the original was published eighteen years ago. The French translation, edited by M. de Margerie, was brought up to date and illustrated by additional maps; but this edition exactly follows the original, and does not even add the date of its first publication. We are, however, frequently reminded of its age by such statements as that the Arctic Ocean is "of very trifling depth," or that the author cannot hazard a guess as to the structure of the Celebes. In many cases the facts stated are now known to be incorrect; but later research has removed Prof. Suess's difficulties probably more often than it has added to them.

The main purpose of this volume is the statement of the evidence for Suess's contention that continents are never uplifted in mass, and that the occurrence of raised shore lines and horizontal sheets of marine rocks is due to the lowering of sea-level, and not to the raising of the land. Suess, therefore, returns to pre-Playfairian geology, for Playfair maintained that the level of the land is less stable than that of the sea. This apparently improbable conclusion became, owing to the brilliant advocacy of Lyell, the fundamental principle of the Uniformitarian school of geology.

The contrary view was dismissed by Herbert Spencer as one of the gratuitous assumptions of what he called "illogical geology." Nevertheless, it is now advocated by the geologist who has probably the widest general acquaintance with geological literature, and is gifted with a scientific insight that has materially advanced each of the many branches of geology to which he has given his attention.

Prof. Suess's argument is that a continental uplift is impossible. A continent may subside, but it cannot be uplifted in mass. Rocks may be raised locally when uptilted during the formation of a mountain chain; but he denies the possibility of the uniform uplift of widespread masses composed of irregular materials. The sea has certainly encroached at times upon the land, and has at others receded; but instead of these changes being due to the sinking and rising of the land, Suess maintains that they are due to variations in sea-level.

That the sea-level is not uniform is indisputable. It varies from causes which need only to be stated to be accepted. The water is heaped up in places by wind and rivers. Elsewhere it is lowered by rapid evaporation, and the surface is maintained at the lower level by the greater weight of the salter water. Thus the surface of the Mediterranean, according to Suess, is funnel-shaped, the lowest part of the funnel being in the area of especially salt water in the neighbourhood of Crete. Variations in wind and rainfall or in the course of rivers; the reduction in the lateral attraction of the land, in consequence of its denudation; the retardation of an on-shore current by increased friction due to shoaling, may all lead to a local retreat of the sea. Thus Suess attributes a raised beach near Bombay to sedimentation having checked the incoming tide, and thus caused a local depression of sea-level. The apparent effect of these causes on the shore-line would be the same as that produced by an actual uplift of the land. As the retreat or advance of the shore-line may be produced by the oscillation either of the land or of the sea, Suess objects to the usual terminology, which always speaks of the uplift or subsidence of the land. To avoid unproved assumptions he speaks of negative and positive movements, according as the sea-level falls or rises relatively to the adjacent land. Sir Archibald Geikie has suggested terms—the emergence and submergence of the land—which are equally noncommittal, and have the advantage of being self-explanatory. The encroachment or retreat of the sea may be a merely local incident or it may be a world-wide phenomenon; in the latter case, Suess speaks of it as a eustatic movement, and explains it as due to an increase or reduction in the capacity of the ocean basins. A negative movement, *i.e.* an emergence of the land, would be caused by an increase in the depth of the oceans by a subsidence of their floor, which lets the water fall away from the land.

This volume may be considered in two sections; in the first chapters Prof. Suess states his heterodox doctrine, and the mass of stratigraphical evidence in its support. In the second section he examines the leading cases relied on by the champions of secular elevation of the land. These two sections of the book appear of unequal value, for they deal with movements of probably different character and origin. The first part describes the great movements of emergence and submergence which are world-wide in their range; Suess's greatest service to geology has been his recognition of this fundamental fact and its consequences. It is a most helpful discovery, and Prof. Suess offers us the only reasonable explanation yet advanced. The evidence is summarised by Suess in chapters ii. to vi. of this volume. Therein he describes and compares in detail the coasts of the Atlantic and the Pacific, and gives a summary of the geological history of the oceans. The striking resemblance in the lithological succession in some of the geological systems in remote parts of the world can only be explained on the assumption that they are controlled by some world-wide agency; this, Suess's fundamental proposition, seems to be supported by the general evidence of stratigraphical geology.

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The second division of the subject is the discussion of the leading cases which have been used to prove the actual uplift and subsidence of the land, such as the raised shore-lines of Norway and northern Europe, the bored pillars of the Temple of Serapis, near Naples, the raised beaches around the Baltic, and the submerged peat bogs and forests on the British coasts. Suess examines these cases in detail, and denies that they give any evidence of secular uplift. He rejects what are generally considered some of the best established of geological truths, such as the still progressive tilting of Scandinavia. Suess denies these popular conclusions, and during his argument claims that both Lyell and Darwin mistook kitchen middens for raised sea beaches. Suess examines the evidence in detail for each case, and maintains that the inferences based on it are invalid. The shore-lines of Norway he claims to have been formed along the shores of glacier-dammed lakes. The Temple of Serapis, he maintains, has no connection with secular movements, because it is actually in the breached crater of a volcano. Submerged forests, he points out, may be due to growth behind storm beaches, or on land along a low shore which has sunk by the shrinkage of an underlying water-logged bed. The raised beaches around the inner Baltic he explains by the gradual lowering of the water by the emptying of that sea. The slow emergence of the north Baltic shore is, therefore, according to Suess, the consequence of a climatic change, not of an earth movement; and Suess advances evidence to prove that the level of the southern Baltic has been constant throughout historic times.

The latter part of this volume is perhaps of most popular interest, but it is the least convincing part of the "Antlitz," and perhaps the least essential to Prof. Suess's main position. Suess admits some cases of uplift, as at the Temple of Serapis, and he admits that some of the lower Norwegian shore-lines are true sea beaches. We may accept Dr. Günther's evidence showing that the uplift near Naples was somewhat wider than Suess admitted, or accept a slow uprise of the land near the great lakes of America, without rejecting the doctrine that the major changes in the range of the sea are due to changes in its level. Suess only briefly refers to the phenomenon of isostasy; and the work of Colonel Burrard in India shows that the plumb-line agrees with the pendulum as to the unequal density of the blocks in the earth's crust; and therefore some areas may have been uplifted to restore that hydrostatic equilibrium at which others are still upheld.

The second division of this volume shows that the easy inference that every submerged forest and every raised beach involves a movement of the land is not justified. Suess shows that they can be explained without any assumption of earth movements. Each case must be judged on its merits. We can accept either the explanation of a limited emergence or submergence of the land without rejecting Prof. Suess's main proposition that, in the geological past, the major changes in the range of the sea have been due to variations in its level. J. W. G.

REFUSE DESTRUCTORS.

(1) *The Disposal of Municipal Refuse.* By H. de B. Parsons. Pp. x+186. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 8*s.* 6*d.* net.

(2) *Garbage Crematories in America.* By W. M. Venable, M.S. Pp. x+200. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 8*s.* 6*d.* net.

(1) THE author has not attempted in this book to produce a treatise dealing with the designing of the details for the final disposal of city refuse, but rather to set forth clearly the principles underlying the sanitary and economic handling and destruction of such material. The book owed its origin to certain designs which Mr. Parsons was engaged upon in connection with the disposal of the refuse of the city of New York, and as a result the bulk of the appliances and plant which the author describes are those which are employed in the Empire City, and there is a number of excellent reproductions of photographs of the methods adopted in that city both for collecting and for disposing of the refuse.

In chapter iii. it is shown that the general refuse for which a method of collection and disposal must be provided can be divided into five classes:—(1) ashes; (2) garbage; (3) rubbish; (4) street sweepings; and (5) snow; and tables are given to show the average composition of the first four of these, and the weight which has to be collected annually in a number of selected American cities; in New York the refuse varies from 2·6 lb. to 4·9 lb. per head per diem. The methods of collecting the various classes of refuse are then dealt with, and the author rightly lays stress on the absolute need of arranging the collections at regular intervals, and of the use of properly designed, covered, and water-tight carts; the important problem of cleansing streets crowded with vehicular traffic is also briefly discussed.

In the next two chapters the methods of disposal are taken up, and the various systems in use contrasted and compared; such processes as those of dumping on land or dumping in water should never be permitted; they are hopelessly insanitary; one of the illustrations—"Disfigurement of Beach by Dumping at Sea"—is a striking instance of the abominable results which may arise from such cheap and nasty methods. Mr. Parsons is evidently of opinion that the reduction process (only applicable when the garbage is separately collected), by which oil and grease are extracted and sold, can never be made a paying process, and it seems, therefore, highly undesirable to put up plants of this nature, when they are liable to produce such serious nuisance from foul smells. It is pointed out that the incineration process, which has been such a success in the cities of England and Germany, has so far not been adopted on a large scale in the United States, but the author considers that this method is bound to become more and more common in the States; where it has been a failure it is entirely due to faulty design of the destructors, and to the desire unduly to cheapen first cost.

Undoubtedly the form of civic government in

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